

Google Inc.
Public Policy Department
1101 New York Avenue, NW
Second Floor
Washington, DC 20005



Phone 202.346.1100
Fax 202.346.1101
www.google.com

December 17, 2007

Ex Parte via Electronic Filing

Marlene H. Dortch
Office of the Secretary
Federal Communications Commission
445 12th Street, SW
Washington, D.C. 20554

Re: Authorized Ex Parte Contact – Unlicensed Operation in the TV Broadcast Bands (ET Docket No. 04-186); Additional Spectrum for Unlicensed Devices Below 900 MHz and In the 3 GHz Band (ET Docket No. 02-380)

Dear Ms. Dortch:

Google Inc. (“Google”), by its attorney, respectfully submits this letter as a follow-up to our December 5, 2007 letter outlining an authorized ex parte contact in the above-referenced dockets. That letter explained how Google demonstrated to FCC staff broadband spectrum sensing technologies which reliably detect digital television (DTV) signals well below the noise floor. Google also demonstrated interference mitigation technologies utilizing short-burst transmissions, which interact well with existing burst error correction in DTVs and FM modulation in wireless microphones. Together, these results demonstrate that DTVs and wireless microphones can be amply protected from harmful interference by unlicensed personal/portable devices, using reasonable power levels and sensing thresholds.

Based in part on the results of these technology demonstrations, Google believes it would be beneficial to enunciate several key points that should help guide the Commission’s decision-making in this proceeding.

The FCC Should Accommodate Hybrid “Fixed/Portable” Networks In Its Requirements

The current record in this proceeding creates an artificial dichotomy between fixed/access unlicensed devices on the one hand, and personal/portable unlicensed devices on the other. The implicit supposition is that a network will consist exclusively of nodes of either one type or the other. However, this assumption overlooks the fact that a “hybrid” network topology that combines elements of both models possesses significant value and practicality. In particular, fixed/access unlicensed devices can serve as base stations (or

access points), while personal/portable unlicensed devices can serve as client nodes, perhaps for laptop computers or wireless in-home local area networks (LANs).

In this hybrid scenario, a personal/portable device would not be allowed to transmit until it first had received a signal from a fixed/access device indicating which channels were safe to use without causing harmful interference to licensed services. As a result, this network configuration essentially marries the best aspects of both worlds. In particular, hybrid networks reduce the risk of personal/portable unlicensed devices interfering with licensed services (as would a network consisting only of fixed/access unlicensed devices), while providing the tangible benefits of mobility, low cost, and ease of installation and use (as would a network consisting only of portable unlicensed devices).

Given the benefits of such a hybrid model, the requirements adopted by the Commission in this proceeding should be extended to reflect the inherent virtues afforded by such a hybrid network. For example, power levels intermediate between those allowed for purely fixed/access devices and purely personal/portable devices should be permitted in such a hybrid network. Moreover, because a personal/portable device in a hybrid network would not be allowed to transmit without first receiving a signal from a fixed/access device, there should be no geo-location requirement for those same personal/portable devices. The Commission should account for these and other material differences in the three network models when crafting applicable technical requirements.

Time Division Protocols Mitigate Any Potential Transmission/Sensing Interference

Some have noted that the process of testing devices should address the possible interaction between transmission and sensing functions. However, Google believes that any such concern is misplaced. Many modern communications systems, such as WiFi and WiMAX, feature time division duplex (TDD) protocols. In such schemes, because the unlicensed device would be silent during the sensing/receiving phase of the communication, the device's transmission will not interfere with its concomitant ability to sense licensed services. Further, time division multiple access (TDMA) schemes can reserve a portion of time strictly for sensing, when no other unlicensed device -- whether fixed/access or personal/portable -- will be transmitting.

Both TDD and TDMA schemes are "future proof," in that they support technological enhancements such as multiple input, multiple output (MIMO), and other "smart antenna" technologies. Moreover, the client nodes in TDD/TDMA schemes are active only a small fraction of time, leaving the overwhelming majority of time available for sensing licensed services. These types of schemes also facilitate the burst transmission interference mitigation techniques that Google demonstrated previously at the OET offices.

Simultaneous Parallel Sensing Greatly Reduces Detection Time

Some also suggest that the time necessary to reliably sense licensed services may reduce its practicality. It is true that a reliable, low-threshold sensing algorithm may take several

seconds to sense one of the thirty available TV channels between 21 and 51, which may appear to require thirty times as much sensing time to detect all 30 channels. However, it is quite practical to implement parallel sensing hardware, capable of detecting all thirty channels simultaneously. In fact, the technology platform Google demonstrated at the OET offices samples the entire 180 MHz of spectrum simultaneously. Due to limitations of the relatively small Field Programmable Gate Arrays (FPGAs) used for that particular demonstration, only one channel could be processed at a time. However, in even a modestly sized, low-cost Application Specific Integrated Circuit (ASIC), the extra digital logic gates required to implement simultaneous parallel sensing would be negligible.

Smaller Wideband Antennas Easily Can Be Implemented

A final claimed concern with the practicality of personal/portable unlicensed devices is the design of their antennas. Google's technology demonstration used a standard discone antenna (specifically, Diamond Antennas Model D130N, "Super Wideband Discone Antenna"). This particular design was chosen for the sake of simplicity, since the properties and radiation pattern of this antenna style are well known. However, entities can design and deploy much smaller antennas capable of wideband sensing, reception, and transmission over the bands of interest (between 512 and 698 MHz). While more simplistic "rubber ducky" antennas may not be appropriate for certain applications, sufficiently wideband antennas easily can be implemented at low cost, by taking advantage of the volume of personal/portable devices.

We trust the above points will clarify and strengthen the record in this important proceeding. The available evidence is clear that unlicensed devices -- fixed and mobile alike -- can coexist successfully with licensed services without any reasonable fear of harmful interference.

Should you have any questions, please do not hesitate to contact the undersigned.

Respectfully submitted,

A handwritten signature in dark ink, appearing to read "R. S. Whitt", is written over the printed name.

Richard S. Whitt, Esq.
Washington Telecom and
Media Counsel
Google Inc.